PB 187 296

THE NATIONAL SOLID WASTES SURVEY

Ralph J. Black, et al

Bureau of Solid Waste Management
Cincinnati, Ohio

1968

CLEARINGHOUSE
FOR FEDERAL SCIENTIFIC AND TECHNICAL INFORMATION

Distributed . . . 'to foster, serve and promote the nation's economic development and technological advancement.'

U.S. DEPARTMENT OF COMMERCE/National Bureau of Standards

This document has been approved for public release and sale.

PB187296

an interim report

1968 NATIONAL SURVEY

OF COMMUNITY SOLID WASTE PRACTICES

Reproduced by the
CLEARINGHOUSE
for Federal Scientific & Technical
Information Springfield Va. 22151

NOTE

The Bureau of Solid Waste Management considers the survey data summarized in this report to be the best indicator of solid waste management practices currently available. This information is preliminary in that it represents partial fulfillment of a national solid waste survey scheduled for completion in 1971. This survey is primarily being conducted by the State solid waste planning agencies in coordination with the Bureau and has as its objective coverage of all the incorporated communities of 5,000 or more population (1960 U.S. Census) plus all portions of Standard Metropolitan Statistical Areas. In addition, several States have indicated a desire to increase the scope of survey coverage to include rural areas as well. A decision was made to release an interim survey report presenting data collected through July 1, 1968, to provide much needed insight into solid waste practices today.

The data has been reported as received and the analyses represent the average values of the responses. It is suggested that users of the data be completely familiar with the survey Manual of Instructions,* the survey forms used for the data acquisition, and Preliminary Data Analysis,† which contains the survey forms and a discussion of data reliability. In general, high reliability can be placed in the land disposal and facility data. Much the same can be said for the community data except for its collection aspects, which have lower reliability. Recognizing the need for additional effort to complete the job, the Bureau is initiating supplementary surveys in the urban, industrial, and agricultural areas, with special emphasis on collection practices.

*Manual of instructions and sample problem for use in conducting the national survey of community solid waste practices. [Cincinnati], Solid Wastes Program, July 1967. 65 p.

†Muhich, A. J., A. J. Klee, and P. W. Britton. Preliminary data analysis; 1968 national survey of community solid waste practices. Public Health Service Publication No. 1867. Washington, U.S. Government Printing Office, 1968. 483 p.

THE NATIONAL SOLID WASTES SURVEY

An Interim Report

Ralph J. Black, Anton J. Muhich, Albert J. Klee,
H. Lanier Hickman, Jr., and Richard D. Vaughan

Presented at the 1968 Annual Meeting of the Institute for Solid Wastes
of the American Public Works Association,
Miami Beach, Florida, October 24, 1968.

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service
Consumer Protection and Environmental Health Service
Environmental Control Administration

THE NATIONAL SOLID WASTES SURVEY

An Interim Report

The Foundation Provided by the New National Data

by Ralph J. Black*

To anyone who has attempted to solve a solid waste management problem, one fact is evident: little reliable information on solid wastes is available. This fact, I am sure, is obvious to many of you who have attempted to plan, design, or update a solid waste collection or disposal system for yourselves or for a client. This fact was also obvious to the participants in the 1966 American Public Works Association Research Foundation Symposium on Solid Waste Research Needs.[1] A conclusion drawn from this symposium was that the two areas of greatest importance to the solid waste field are: first, the application of systems analysis and operations research methods, and second, the development of adequate and reliable data. Most important, however, is that this need for reliable data was also recognized by the Congress of the United States.

---

*Deputy Chief, Solid Wastes Program, Environmental Control Administration, Consumer Protection and Environmental Health Service, Public Health Service, U.S. Department of Health, Education, and Welfare.

Among the items authorized by the Solid Waste Disposal Act (PL 89-272), passed by Congress in October 1965, is a provision for grants to state and interstate agencies for conducting surveys of solid waste practices and for developing solid waste disposal plans. To date, 38 states, the District of Columbia, Puerto Rico, and 3 interstate agencies have received solid waste planning grants.

Prior to passage of the Solid Waste Disposal Act, few states had established solid waste programs. Thus, because of a lack of experience and personnel, most states were unable to develop and plan the required data-gathering activities. In July 1966, the states, recognizing this deficiency, recommended, through the Conference of State Sanitary Engineers, that the Federal Solid Wastes Program prepare a list of essential data and guidelines for conducting the statewide surveys. Our response to this request resulted in the development and initiation of the National Survey of Community Solid Waste Practices.

The data listings, reporting forms and specifications for the Survey were developed over a period of more than five months through the joint efforts of representatives of the Solid Wastes Program, state agencies, and consultants. In order to provide maxiumum flexibility in conducting the survey and recording results, three reporting forms were devised, one to report on the "community" itself and the other two for disposal sites only. The Community Description Report[2] embraces four broad areas: (1) storage, (2) collection, (3) disposal, (4) budget and fiscal. The two disposal

forms, Land Disposal Report[3] and Facility Investigation Report,[4] focus on three areas: (1) description and evaluation of site, (2) quantitative data, (3) fiscal data. In addition, the facility form contains a separate section on the design features and operational characteristics of incinerators.

Although the survey was designed by the Solid Wastes Program, the basic data was collected for the most part, by the respective state solid waste planning agencies. The states forwarded their completed survey forms to the Program's Systems and Operations Planning Activity where the data was verified, coded, and key punched. The Cards were then processed in a Honeywell-400 computer. Tabulated computer printouts of the information were produced and returned (along with punched cards) to the states so that errors in coding or keypunching could be corrected and the data verified.

In addition to merely storing and retrieving the survey data, we have made some preliminary statistical analyses of the information received by July 1, 1968. The information analyzed was concerned principally with the location, types, and amounts of solid wastes being collected and their disposition, and the resources (manpower, equipment, facilities, monies, etc.) required to carry out collection, processing, and disposal activities. Some of the data we will be presenting this morning will reinforce some of your current opinions, some data may cause you to develop new opinions, and some data may have no effect at all.

The raw survey data as well as the preliminary data analysis will be published by the Department of Health, Education, and Welfare as Public Health Service publications,[5],[6] so that the information will become widely available as quickly as possible. Undoubtedly the Federal publications will be followed by a series of intensive statewide studies and resultant publications, such as the recent report on the status of solid waste management in California.[7] State participation has been an organic part of the National Survey process and the feedback of the information to the states--where it can be used--is the prime justification for the Survey.

To proceed with the rest of our program this morning, Dr. Anton J. Muhich, Chief, Systems and Operations Planning, will first discuss the coverage, representativeness and reliability of our survey sample and then present some of the highlights from the community description forms. Mr. Albert J. Klee, Chief, Operational Analysis, Systems and Operations Planning, will present some results from the land disposal and facility forms. Mr. H. Lanier Hickman, Jr., Chief, Technical Services, will discuss the implication of these results on our technical assistance program. Mr. Richard D. Vaughan, Chief, Solid Wastes Program, will then summarize and begin to relate the results of this community survey to the total spectrum of solid waste management for the nation.

References Cited

1. Solid wastes in perspective; proceedings of a symposium on research needs, Philadelphia, Jan. 28-29, 1966, American Public Works Association Research Foundation, APWA Institute for Solid Wastes. Chicago, American Public Works Association, 1966. 18 p.

2. Public Health Service Form, PHS 4944-1 - 4/67 - BOB 68-S67-022.

3. Public Health Service Form, PHS 4944-2 - 4/67 - BOB 68-S67-022.

4. Public Health Service Form, PHS 4944-3 - 4/67 - BOB 68-S67-022.

5. Muhich, A. J., A. J. Klee, and C. R. Hampel. 1968 National survey of community solid waste practices. Public Health Service Publication No. 1866. Washington, U.S. Government Printing Office, 1968. (In press.)

6. Muhich, A. J., A. J. Klee, and P. W. Britton. Preliminary data analysis; 1968 national survey of community solid waste practices. Public Health Service Publication No. 1867. Washington, U.S. Government Printing Office, 1968. (In press.)

7. California State Department of Public Health. Status of solid waste management; California solid waste planning study. v.1. Interim report. September 1968. 306 p.

Sample Representativeness and Community Data

by Anton J. Muhich*

Although 38 states are in receipt of planning grants, only 30 states and the District of Columbia had contributed data to our survey before July 1, 1968. However, an additional 3 states, Indiana, Iowa, and Kansas, were partially surveyed by personnel of our Program in cooperation with the state agencies and that data is included in our analysis (Figure 1).

The data we will be presenting this morning is from 6,259 communities, representing an estimated 92.5 million persons or approximately 46 percent of the population of the United States. Statistically speaking, our sample is quite large.

Our sample, on a population basis, is approximately 75 percent urban, the remainder being rural. This is to be compared with an estimated 73-percent-urban population of the nation in 1966.

For administrative purposes, the Department of Health, Education, and Welfare divides the United States into nine regions (Figure 2). The Bureau of the Census has also divided the country into nine areas using a socioeconomic criteria. These census divisions, although not matching exactly, are not dissimilar to the HEW regions. We felt, therefore, that if our current sample represented each HEW region, it would represent the nation.

---

*Chief, Systems and Operations Planning, Solid Wastes Program.

PRECEDING PAGE BLANK

The coverage of each individual region ranged from about 20 to 80 percent (Table 1). The portion of the sample in each region ranged from 2 to 26 percent. This is to be compared with the portion of the national population in each region which ranges from 2 to 20 percent. Although our sample does not coincide exactly with the nation in terms of regional coverage, the figures are relatively proportional. Thus, although the statistical purist might argue that our sample may not represent the nation, a realist would say, "Yes, but it's not bad."

TABLE 1. SAMPLE COVERAGE

HEW Region	% Region surveyed	% Sample in region	% Nation in region
1	23	3	6
2	67	27	19
3	51	12	11
4	16	4	11
5	29	13	20
6	22	4	8
7	54	12	10
8	43	2	2
9	79	23	13

The survey was implemented by the individual states as a field investigation, with individuals or teams of data collectors actually visiting the communities and sites. Information was obtained either by personal interview or direct observation. The states were instructed that under no circumstances was a form to be completed on a "mail out and return" basis. In addition, the Solid Wastes Program developed a

manual of instructions, including sample problems, for conducting the survey. To promote additional consistency, we held seminars and workshops to discuss survey techniques, etc., in detail. Thus, by using the personal interview technique and by providing sufficient guidance to the interviewer through the instruction manual and seminar presentations, we anticipated that the data would be both uniform and reliable. However, we were also interested in the quality of the data. Accordingly, each state was requested to evaluate their data, question by question, in terms of good, fair, or poor. In general, we found that high reliability can be placed in the land disposal and facility data except for the information on the quantities of materials collected. The same is true of the community description data. But a poor rating in these areas was anticipated beforehand and the securing of even rough estimates was considered to be a significant accomplishment.

A report detailing the statistical reductions, on which our presentation today is based, is in press.[1] This report presents analyses on national, urban-rural, and regional bases. In addition, the raw data itself will be made available in a nine-volume edition (by region) which is also in press.[2]

In presenting our data this morning, we will generally be talking about national averages computed on a population basis. Careful attention must be given to this interpretation since what is presented on a population basis may differ from that on a community basis. Similarly, the national average may differ from that of its urban or rural contingent.

[1,2]See references 6 and 5 cited in Mr. Black's presentation.

For example, on a national basis, 41 percent of the communities operate their own collection systems (Figure 3). However, when weighted by the population in these communities, this figure becomes 64 percent. Similarly, 64 percent of the urban and only 24 percent of the rural communities operate collection systems. On a population basis these figures become 77 percent and 22 percent respectively.

Thus, 64 percent of our population lives in communities that operate some type of collection system. Approximately 70 percent of the population lives in communities that actually operate a disposal site or facility of some type (Figure 4).

Our data on who collects the various types of solid waste reveal an interesting picture. For household wastes, 56 percent is collected by public collectors, 32 percent by private collectors, and the individual householder himself must take care of 12 percent of the household wastes (Figure 5). For commercial wastes, only 25 percent is handled by public collectors, 62 percent by private collectors and 13 percent by the establishment itself. For industrial wastes, 13 percent is collected by public collectors, 57 percent by private collectors, and 30 percent is handled by industry itself.

Let us now look at the types of household collection systems employed in the nation. Approximately 33 percent of the population lives in communities that operate separate collection systems, that is, in which garbage or rubbish must be separated for collection (Figure 6). Approximately 56 percent lives in communities with combined collection systems.

About 11 percent lives in communities that operate combined and separate collection systems simultaneously. In general, the rural areas have a higher predominance of combined systems with less duplication of effort in the "both" category than its urban counterpart.

For systems with a combined pickup, 48 percent of the material is collected once per week, 32 percent twice per week, and 20 percent at a frequency other than once or twice per week (Figure 7). For systems where garbage must be separated, 61 percent of the material is collected once per week, 29 percent twice per week, 3 percent at some other frequency, and 7 percent of the garbage, although separated, is not collected. For those systems where rubbish was separated, 66 percent is collected once per week, 17 percent twice per week, 9 percent other, and 8 percent of the rubbish, although separated, was not collected.

Our data show that one solid waste collector or driver is employed in the public or private sector for every 590 persons. Extrapolating to the nation, this indicates that more than 337,000 persons are involved in collecting and transporting solid waste from various sources (Figure 8). About 53 percent of these people are employed in the public sector with 47 percent being used in the private sector. For the public sector, about 75 percent are involved in collecting household and commercial wastes, 5 percent are used for industrial wastes and 20 percent for street cleaning. In the private sector only 65 percent are employed in collecting household and commercial wastes while 27 percent are employed in the industrial area with only 8 percent for street cleaning.

Our data show that there is one compactor truck available for each 2,100 persons. Extrapolating to the national level, over 93,000 compactor trucks are being used by public and private collectors (Figure 9). The relative split of these vehicles between the public and private sector is 47 percent public, 53 percent private. Looking at the wastes these trucks carry for the public sector, 94 percent are used for household and commercial, 4 percent for industrial and 2 percent for street cleaning. In the private sector 71 percent are used for household and commercial, 23 percent for industrial, and 6 percent for street cleaning.

For collection vehicles other than compactors, our sample showed one for every 1,100 persons. Extrapolating to a national basis, about 179,000 collection vehicles other than compactors are being used to transport the nation's solid waste (Figure 10). Approximately 80 percent of these vehicles are used in the private sector and only 20 percent in the public sector. For the public vehicles, 47 percent are employed in the household-commercial area, 5 percent industrial, and 48 percent street cleaning. In the private sector, 30 percent of the vehicles are being employed in the household-commercial area, 68 percent industrial, and 2 percent street cleaning.

On the average, approximately 5.32 lbs of solid wastes are collected each day for each person in the nation (Table 2). Of this, about 3 lbs is estimated to be household in origin, 1 lb commercial, 0.59 lbs industrial and 0.18 lbs demolition and construction. These figures differ somewhat on an urban-rural basis. It is emphasized that these are average figures for the nation. Furthermore, they reflect only material known or estimated to be collected. Household, commercial, industrial,

demolition, agricultural, and other wastes that are transported or disposed by the individual generator are not included. Thus, although these figures appear reasonable, they are undoubtedly low.

TABLE 2. AVERAGE SOLID WASTE COLLECTED
(Pounds per person per day)

Solid wastes	Urban	Rural	National
Household	1.26	0.72	1.14
Commercial	0.46	0.11	0.38
Combined	2.63	2.60	2.63
Industrial	0.65	0.37	0.59
Demolition, construction	0.23	0.02	0.18
Street and alley	0.11	0.03	0.09
Miscellaneous	0.38	0.08	0.31
TOTALS	5.72	3.93	5.32

The average community budget is approximately $1.42 per person per year for disposal activities, about one-sixth of which is for capital expenditures (Table 3). For communities actually operating disposal systems, approximately $2.17 per person per year are expended, about one-third being for capital expenditures. For collection activities, the average budget for all communities in the country is $5.39 per person per year, with 10 percent going for capital expenditures. The collection budgets for communities that actually operate their own systems are $5.60 per person per year for a once-a-week system and $6.82 per person per year for a twice-per-week system. From this we could conclude that twice-a-week collection costs only about 20 to 25 percent more than once-per-week collection.

TABLE 3. BUDGETED COMMUNITY EXPENDITURES
(Dollars per person per year)

	Excluding capital	Capital only	Total
Disposal			
Average for all communities	1.17	0.25	1.42
Communities operating disposal systems	1.46	0.71	2.17
Collection			
Average for all communities	4.86	0.53	5.39
Communities operating 1/wk systems	4.85	0.75	5.60
Communities operating 2/wk systems	5.67	1.15	6.82

Looking at the percent allocation of these budgeted community funds, the familiar 80 to 20 split between collection and disposal is evident (Figure 11). An interesting question now arises. Does this 80 to 20 allocation reflect the relative importance of these two areas or does it reflect the preference for investing in one area with relative indifference to the other? What I am suggesting is that this 80 to 20 split exists because, as a nation, we have tended to emphasize collection service and have virtually ignored proper disposal practices. The data Mr. Klee will now present on disposal operations will support this contention.

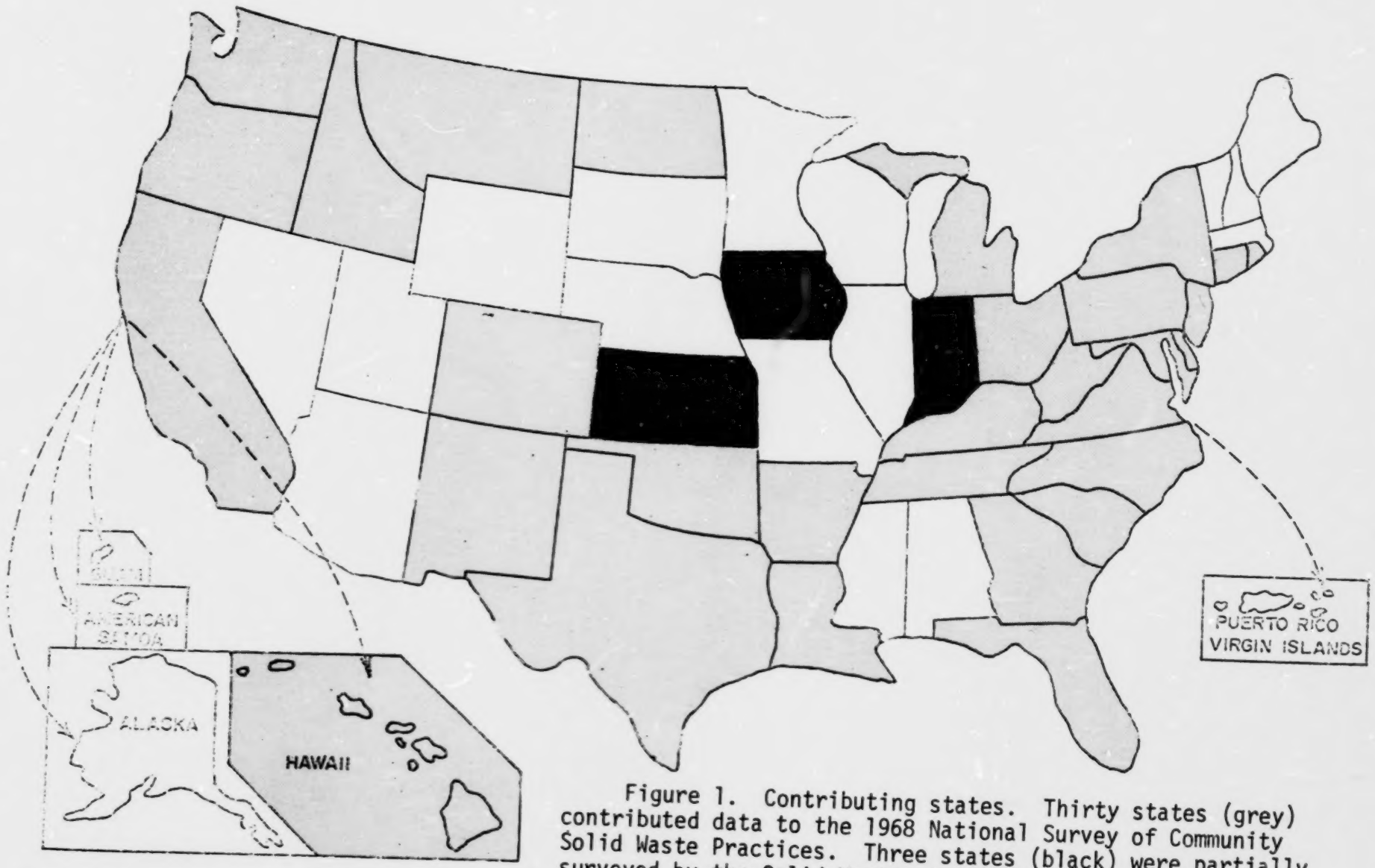


Figure 1. Contributing states. Thirty states (grey) contributed data to the 1968 National Survey of Community Solid Waste Practices. Three states (black) were partially surveyed by the Solid Wastes Program, and that data is included in the analysis.

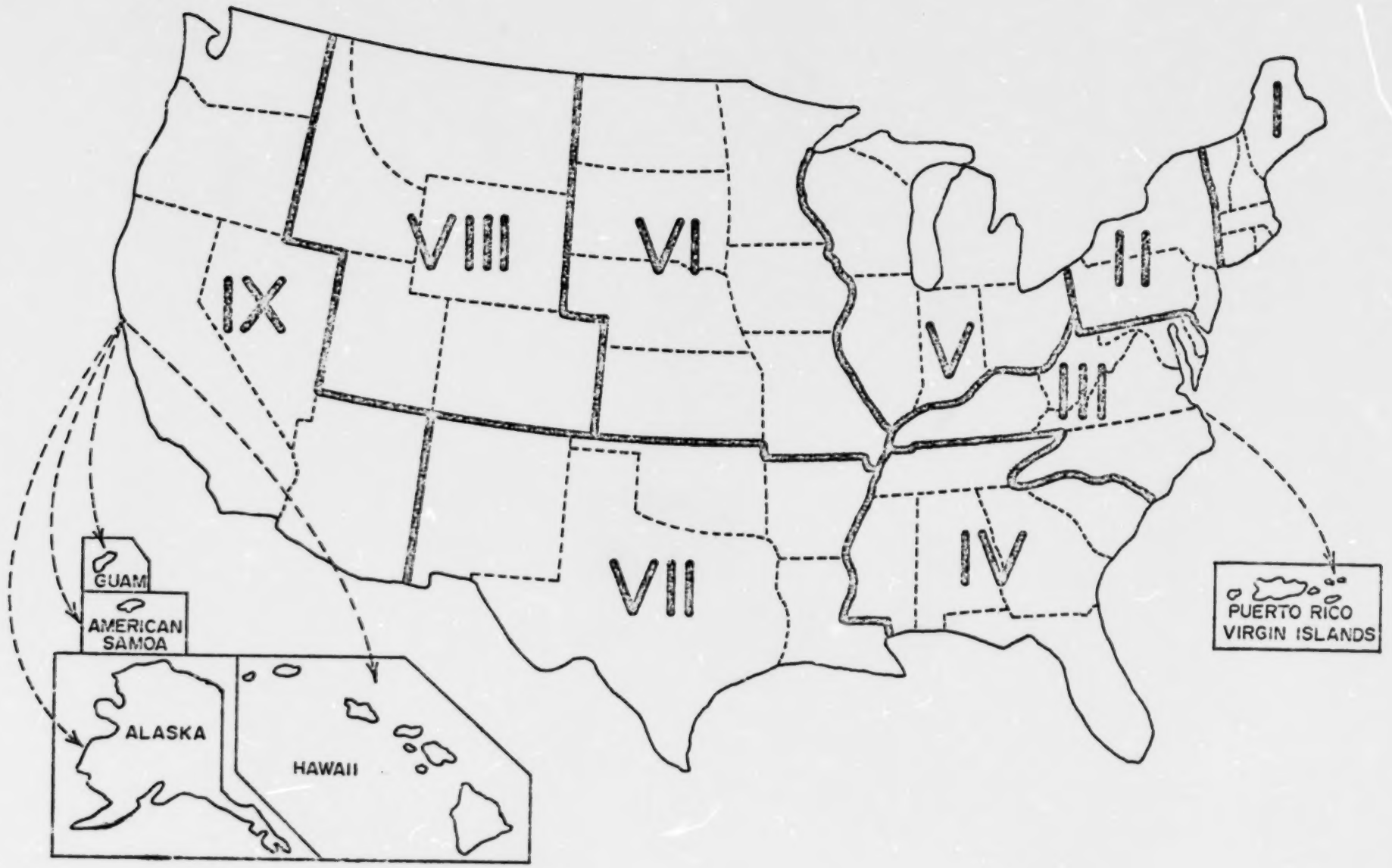


Figure 2. U.S. Department of Health, Education, and Welfare administrative regions. In order to maintain direct contact with state and local authorities, with field offices of other Federal agencies, and with other official and nonofficial organizations, the U.S. Department of Health, Education, and Welfare maintains nine regional offices. Each office works with the authorities of the states within the region in developing and maintaining plans, programs, and budgets for federal-state cooperative health programs. The Federal solid wastes program is represented in each HEW region.

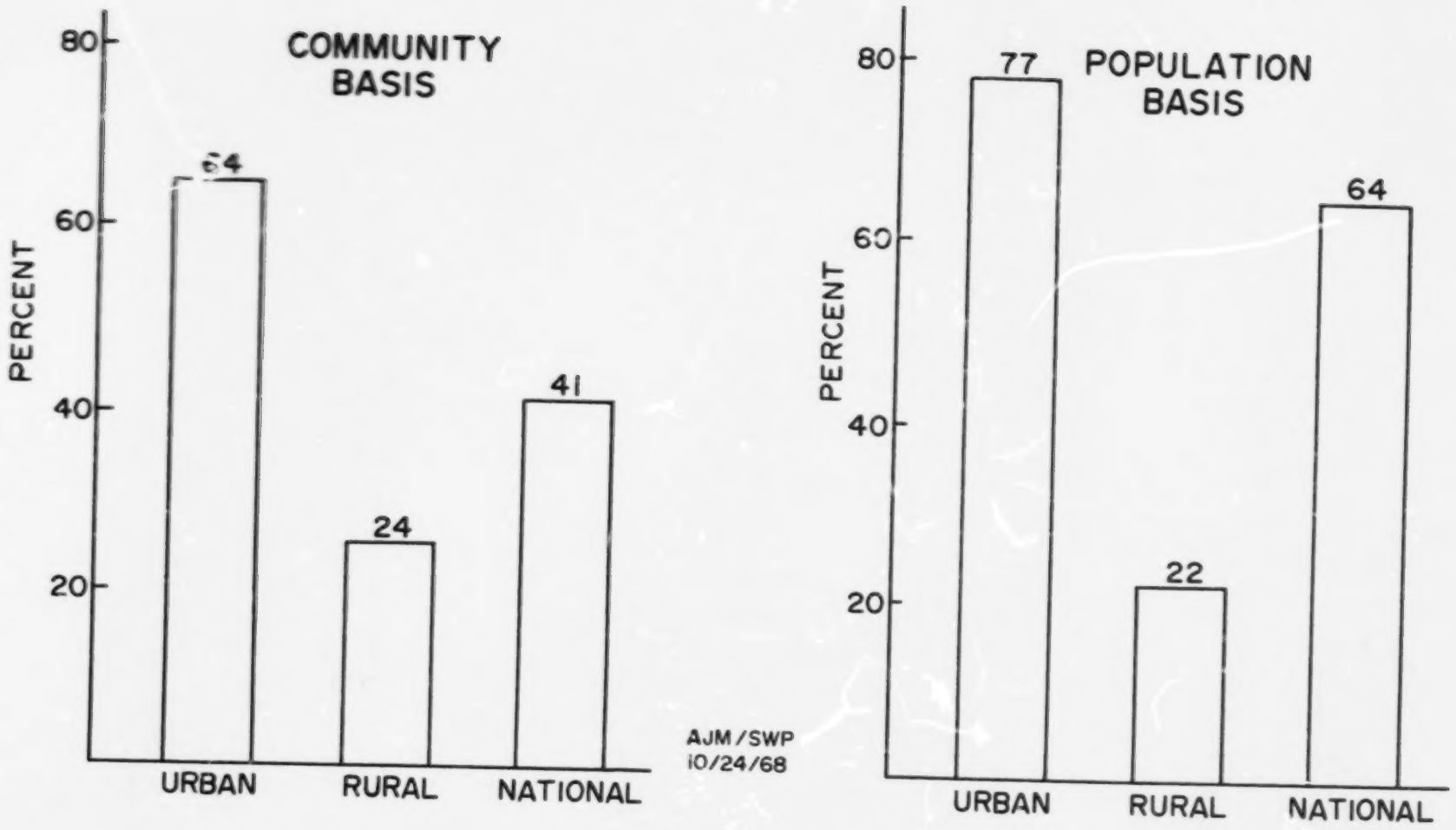


Figure 3. Community operation of collection systems in the U.S. (1968).

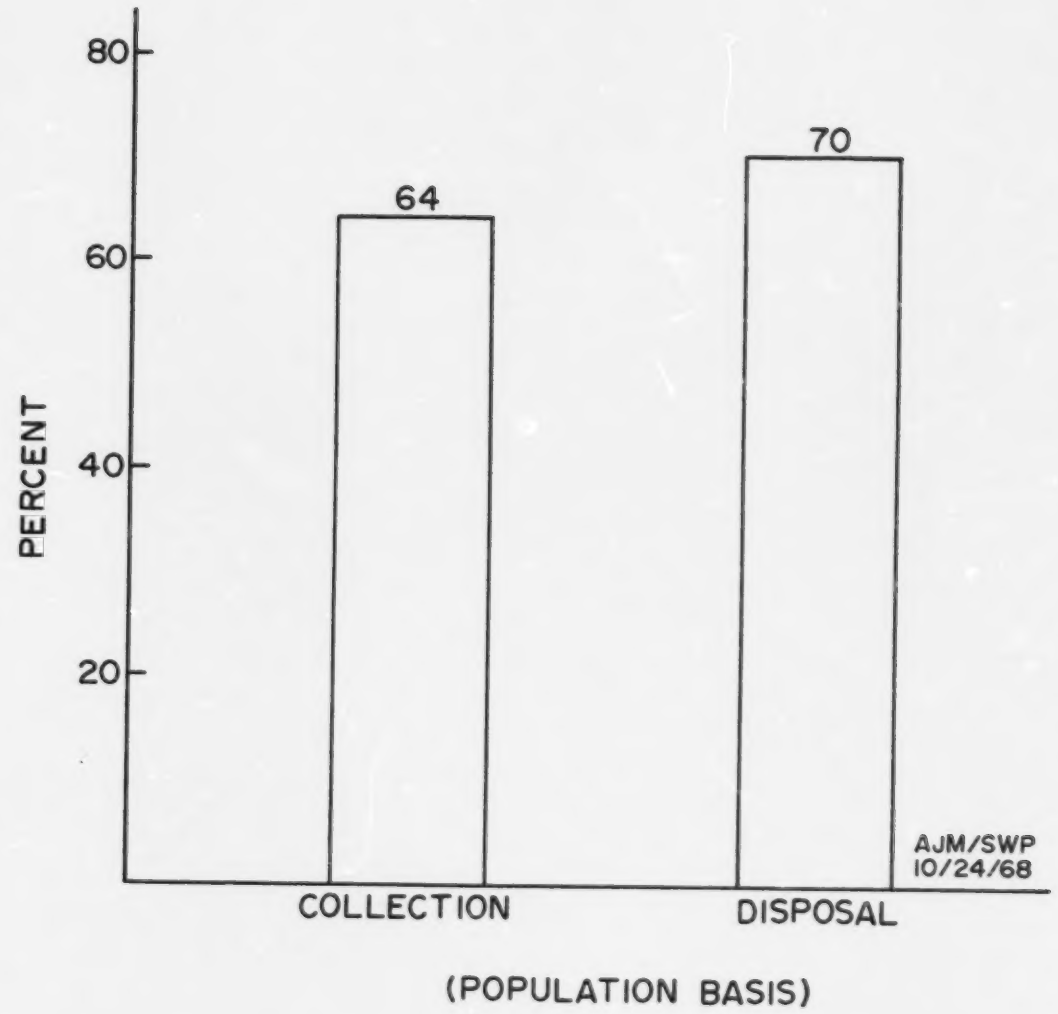
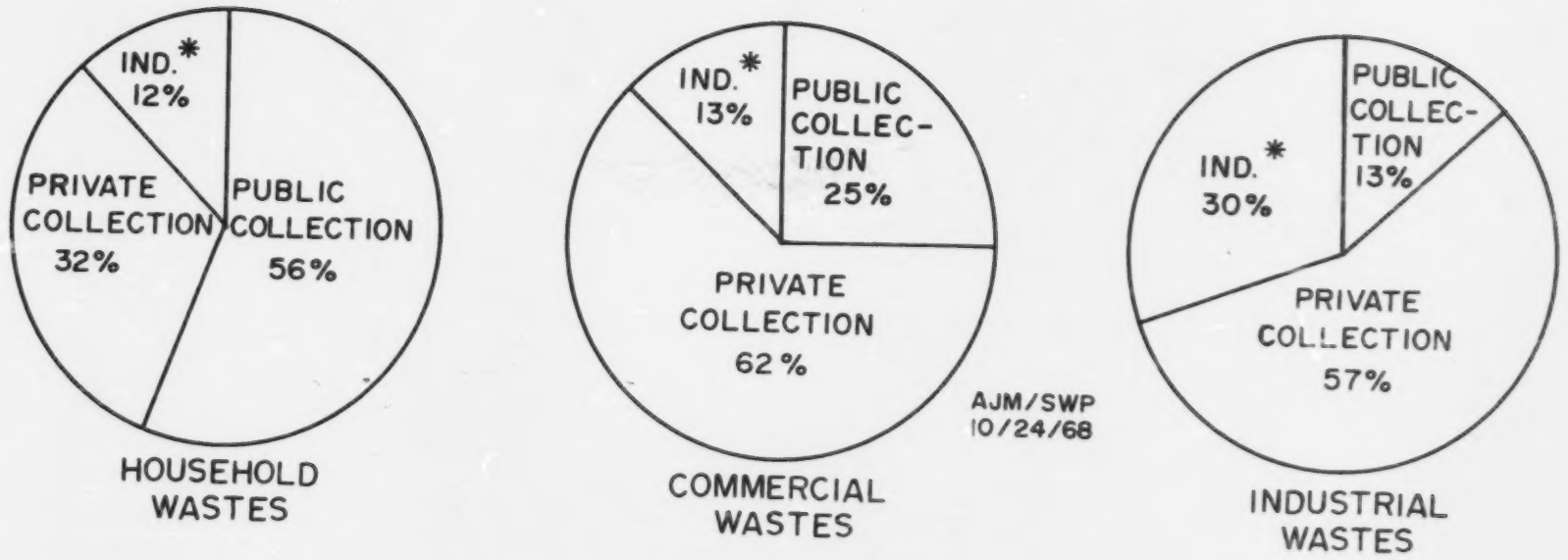


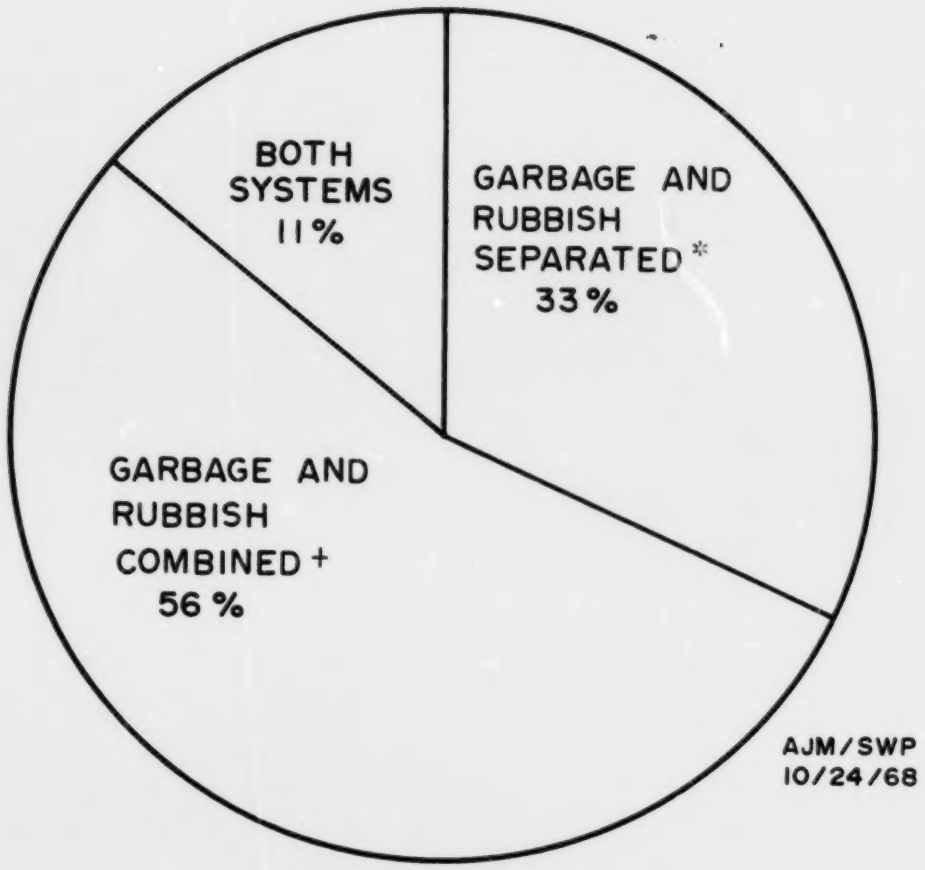
Figure 4. Percent of population in U.S. communities operating collection and disposal systems (1968).



(POPULATION BASIS)

Figure 5. Performance of solid waste collection in the U.S. (1968).

*Ind., collection by individual householders, institutions, or industries.



(POPULATION BASIS)

Figure 6. Types of household solid waste collection systems employed in the U.S. (1968).

---

*Systems in which garbage or rubbish must be separated for collection.
+Systems in which garbage and rubbish are combined for collection.

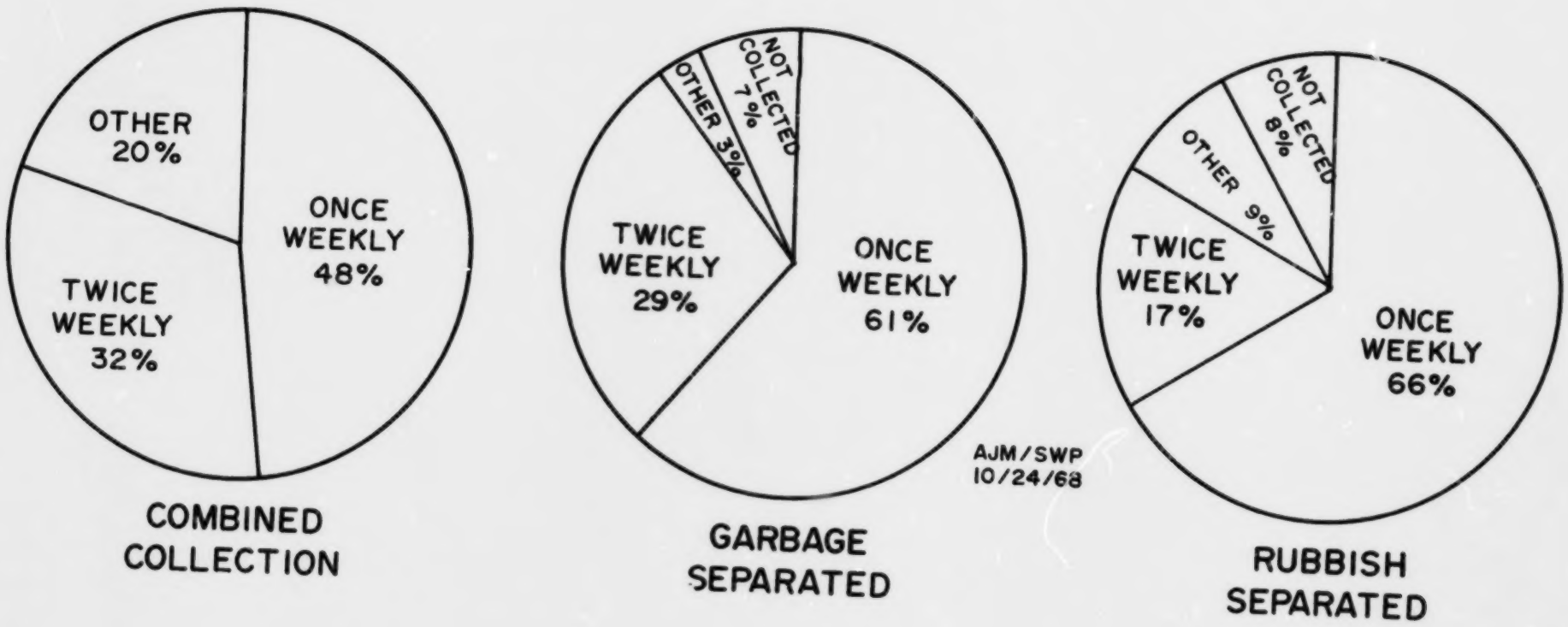


Figure 7. Solid waste collection frequency in the U.S. (1968).

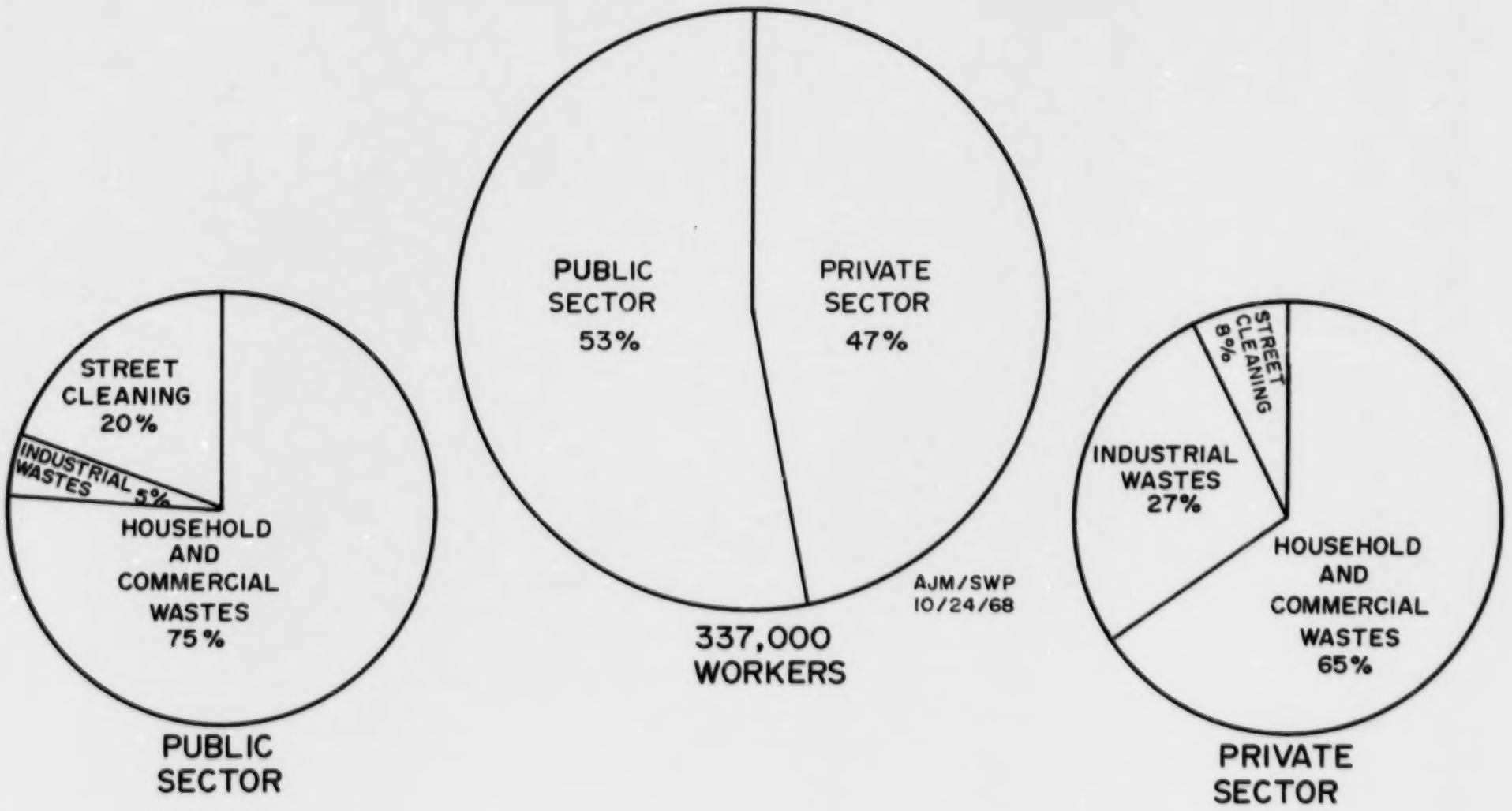


Figure 8. National utilization of manpower in solid waste collection (1968).

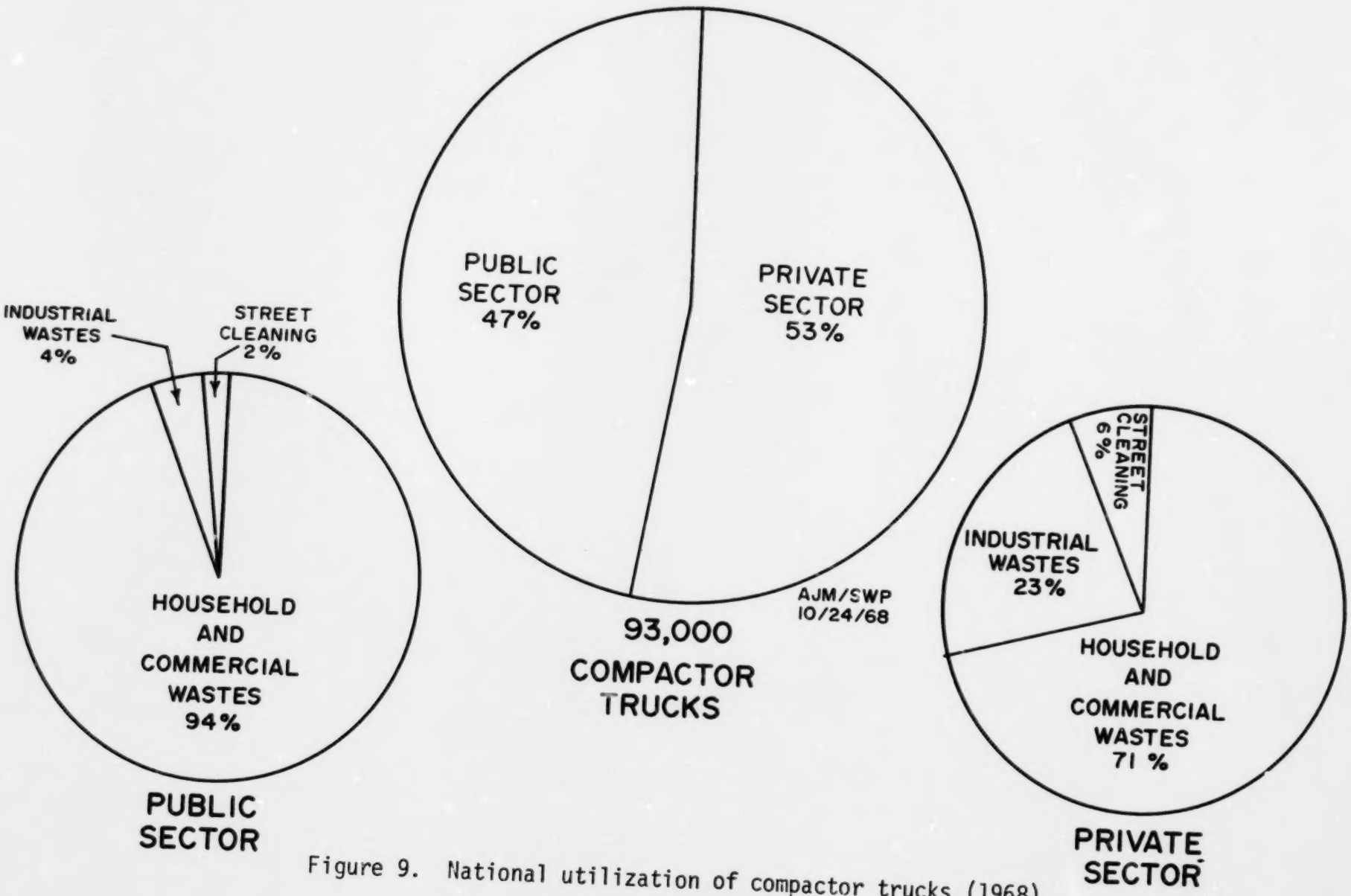


Figure 9. National utilization of compactor trucks (1968).

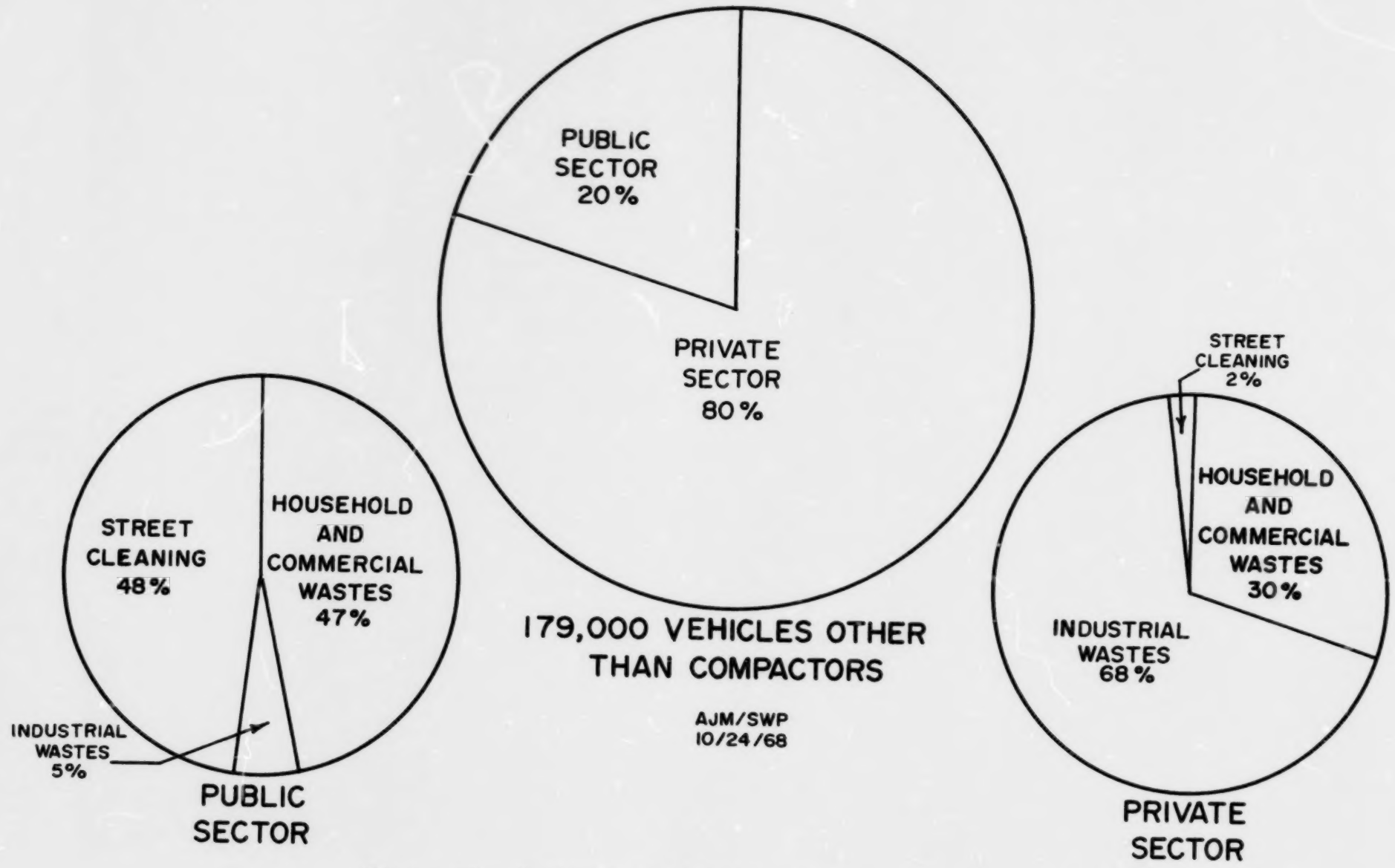


Figure 10. National utilization of other vehicles (1968).

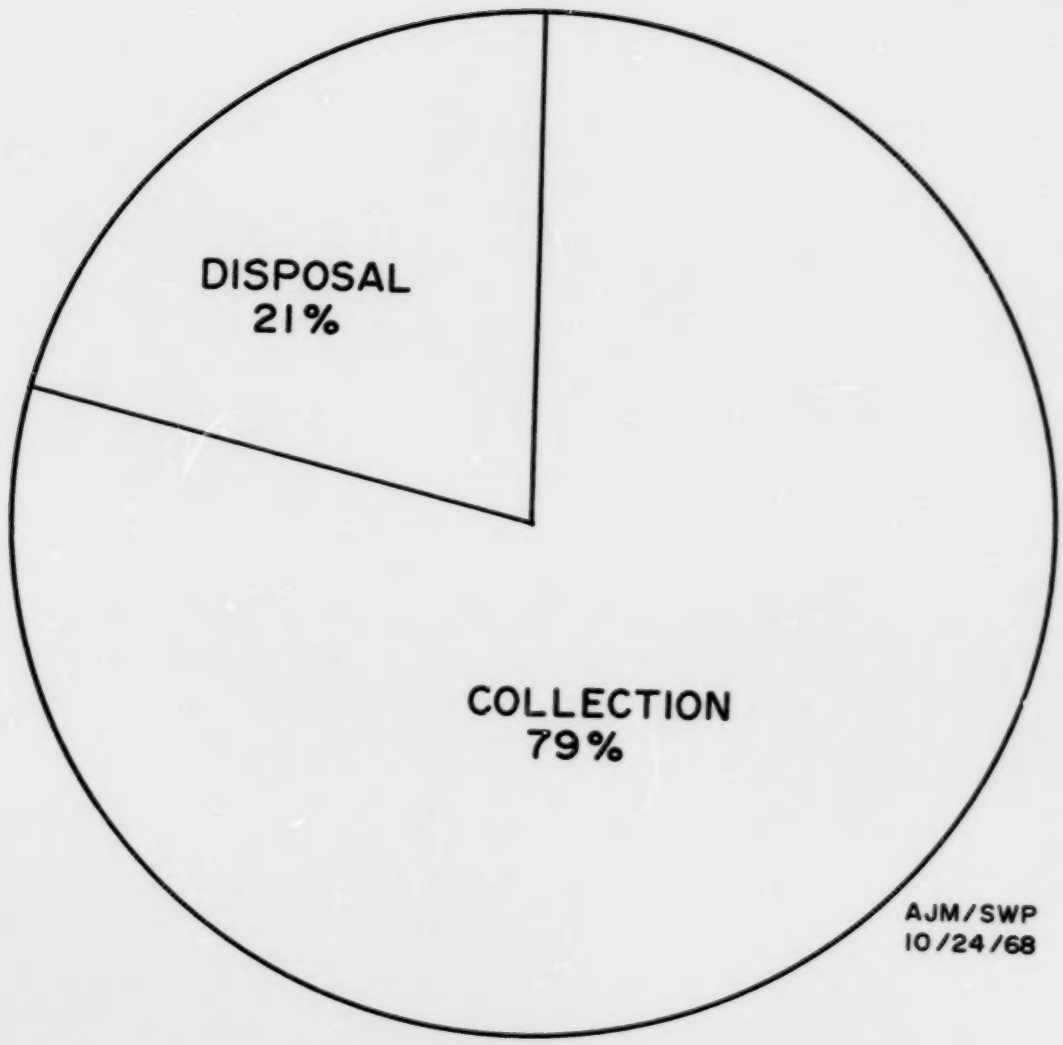


Figure 11. Allocation of community funds for solid waste collection and disposal services and equipment in the U.S. (1968).

BLANK PAGE

The Role of Facilities and Land Disposal Sites

by Albert J. Klee*

The general purpose of the land disposal investigation aspect of the Survey is to determine the disposal capabilities, the costs and method of operation of all land disposal sites within a state. The current status of the sample stands at a little over 6,000 sites, where, for purposes of the Survey, a land disposal site includes any location, whether publicly or privately owned or operated, on which there is dumping of solid wastes by public or private collectors. Included are any privately owned locations where householders or other persons dump their refuse with the permission of public authorities and the private owner. Other dumping sites of such magnitude as to require public attention by state or local authorities also are covered. However, so-called "promiscuous," or unauthorized dumps at the roadside or in public or private areas on which dumping occurs on an irregular or infrequent basis, are not considered land disposal sites for these reporting purposes.

Private sites owned and operated by industrial, commercial, or institutional establishments, and used solely for disposal of their own solid wastes, are not the specific object of the Survey. However, if these sites were surveyed, the information was processed along with the others, in order that such data not be lost for posterity.

---

*Chief, Operational Analysis, Systems and Operations Planning, Solid Wastes Program.

PRECEDING PAGE BLANK

The survey for land disposal sites encompasses four general areas of information. These areas are as follows: a community description, a description and evaluation of the site, quantitative data such as tons delivered to the site, and fiscal data such as operating costs. The relationship of the characteristics of the community to these other areas requires a somewhat sophisticated analysis, and such results are not available at this time. However, it is possible to compare the involvement of the public with the private sector, with regard to operation and ownership of land disposal sites (Figure 12).

Considering all 6,000 sites, we find public operation of 79 percent of them, the remainder being operated privately. Because many municipally-operated sites are leased, however, the fraction publicly-owned is somewhat lower, about 63 percent. The public involvement is, nonetheless, considerable.

The Survey form provides for an answer, by the investigator, to the following question: "Is this a sanitary landfill?" The answer is based upon the interviewer's interpretation of the term, no guidelines being provided by the Survey instructions. Fourteen percent of the 6,000 sites were judged by the interviewers to be sanitary landfills (Figure 13). However, the Survey form itself permits a fair evaluation of the site under consideration. Accordingly, special calculations were made based upon the following criteria for a site to be termed "sanitary": (1) the site must have daily cover; (2) the site must not practice open burning; and (3) the site must not have water pollution problems. Utilizing these somewhat modest criteria, the 14 percent of the fills termed "sanitary"

were evaluated and, in the end, almost two-thirds were rejected as being unacceptable. In reality, then, only 6 percent of this sample of 6,000 can be reasonably characterized as "sanitary landfills." This would suggest that perhaps there is still some confusion about this term, and that some retraining is in order.

What is wrong with our sites is reflected in Figure 14. Only 14 percent of the sample indicated that daily cover was used; 41 percent indicated no cover at all. Only a bit over one-quarter of the sites have an acceptable appearance, and there is some form of open burning on three-quarters of all the sites investigated.

Sanitary landfilling, of course, costs more than inadequate landfilling. The sanitary 6 percent of the 6,000 sites investigated (which handled, on the average, about 27,000 tons per year at each site) indicated an average total operating-plus-amortized capital cost of $1.05 per ton; for a sample of inadequate sites of about equal size this was 70¢ per ton. However, the average inadequate site accepted 11,000 tons of wastes per year at a cost of 96¢ per ton. For sanitary landfills of this size, the average cost was $1.27 per ton. To upgrade all current operations, not just those represented by the sample, it is estimated that some $244 million of capital funds would have to be invested over a period of ten years for equipment alone. An additional $81 million per year would be needed in operating funds. These figures do not include the costs which would be involved in supplying the cover needed to eradicate the prior insults to our environment, nor do they reflect the fact

that sanitary landfilling consumes land at a rate 71 percent greater than does inadequate landfilling. With regard to the latter, however, it must be remembered that new technology may greatly modify this present land utilization picture.

An investigation of solid waste facilities is also part of the Survey. This is intended to provide information about the operating characteristics and capabilities of all solid waste reduction or disposal facilities within a state, other than land disposal sites. Such facilities include incinerators, grinders, crushers, transfer stations, compost plants, conical burners and hog feeding lots. Not included, however, are on-site disposal or reduction facilities such as apartment house incinerators and household garbage grinders. Private facilities owned and operated by industrial, commercial, or institutional establishments and used solely for reduction or disposal of their own solid waste are not the primary object of the survey, but such are not excluded if they are surveyed.

Public ownership and operation is involved in 96 percent of the 142 incinerators, 76 percent of the 43 transfer stations, and 59 percent of the 23 conical burners included in the sample (Figure 15). Such facilities are generally located in areas zoned for industry, although one-quarter of all incinerators are located in residentially zoned areas. These incinerator facilities, however, are more sightly than the other facilities noted (Figure 16). Only two-thirds of the transfer station and one-third of the conical burner operations had a satisfactory appearance. It is interesting to note in passing, since they were not included

in this diagram, that, in general, the 262 hog-feeding lots studied had a more sightly appearance, relevant to their location, of course, than had most conical burners!

Figure 17 indicates the daily input of three types of facilities. The average incinerator processed 188 tons per day, but this low figure is partly due to the small input of those incinerators constructed prior to 1950. The average daily input to incinerators built after 1950 is between 230 and 400 tons. Input to the transfer stations studied averages 375 tons per day and to the conical burners, 41 tons per day. Although not noted on the diagram, the average hog-feeding lot consumed about 4 tons per day of garbage. It is estimated, from these survey data, that approximately 8 percent of the solid wastes collected in the United States is burned in incinerators, and that almost 4 percent of the garbage collected is consumed by hogs.

A broad picture of the operating and capital costs of the three basic facility types shown in Figure 18. The operating costs, per ton, of incinerators, transfer stations and conical burners are approximately $4.50, $1.10 and $1.60 respectively. For capital costs, the analogous figures are $7,100, $1,100, and $1,700.

As disposal in conical burners is merely a controlled form of open burning, our primary interest is drawn to bona fide incinerators. It is possible to classify survey incinerators into three types. Class 1 incinerators are defined as those satisfying the following criteria: (1) they were constructed in or after 1950; (2) they have two or more furnaces; (3) reduction is a minimum of 75 percent by either weight or

volume; (4) the facility has operating air pollution equipment. Class 2 is identical except for the air pollution criterion. Class 3 encompasses all other incinerators. As it turns out, however, all of the criteria for these classifications can be related to the age of the incinerator. The newer incinerators, for example, are the ones tending to have operating air pollution equipment. Thus, the three classes can be adequately characterized by their average ages.

It is possible to compare the reduction capabilities of incinerators in age classes selected on the basis of the previously-stated criteria (Figure 19). By weight these figures are 79, 70, and 65 percent respectively; by volume the corresponding figures are 85, 82, and 76 percent.

This now permits a comparison of incinerator operating costs not only on a tons-in basis, but on a tons-reduced basis as well (Figure 20). On a tons-in basis, the operating costs of the first two incinerator groups are $3.27 and $4.05 per ton respectively. The last category has an operating cost of $5.37 per ton processed. When placed on the basis of tons-reduced, however, these costs are $4.06, $5.79, and $8.26 per ton, respectively.

This, then, is a sample of the information currently being gleaned from the survey results. With time, of course, more ambitious and sophisticated analyses will be made to determine the complete role of facilities and land disposal sites in the overall solid wastes picture.

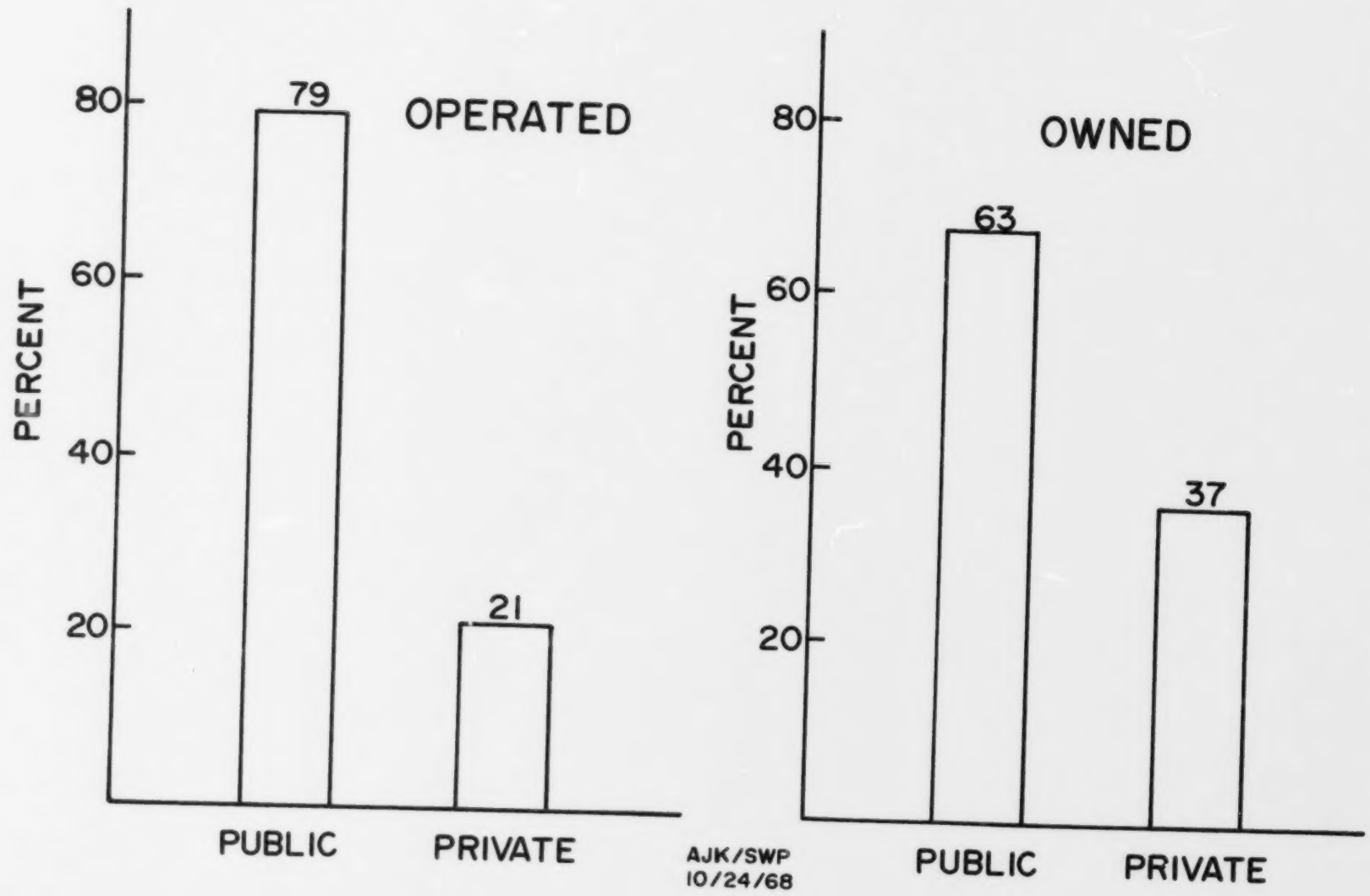


Figure 12. Characteristics of U.S. land disposal sites (1968).

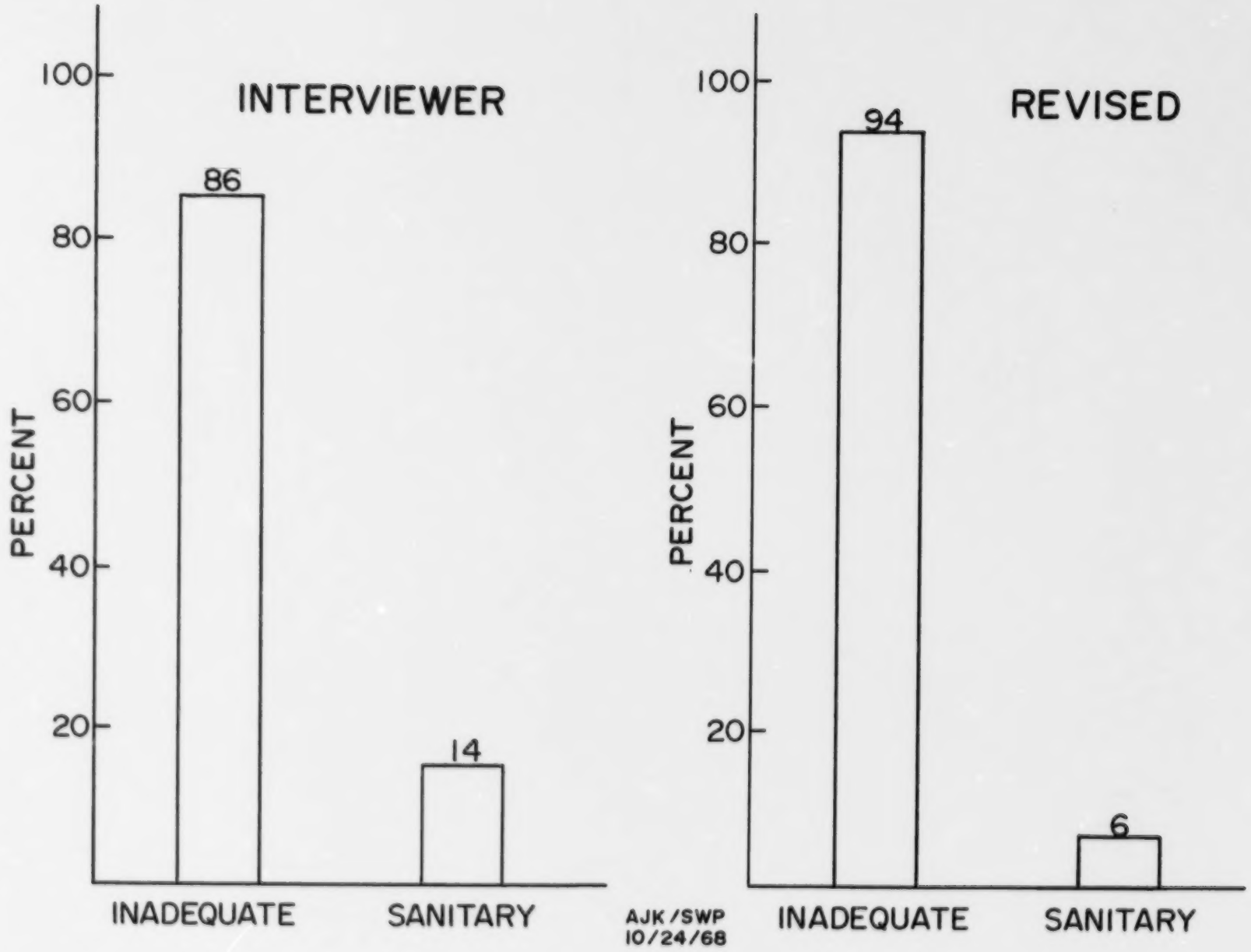


Figure 13. Percent of U.S. land disposal sites characterized as sanitary landfill (1968).

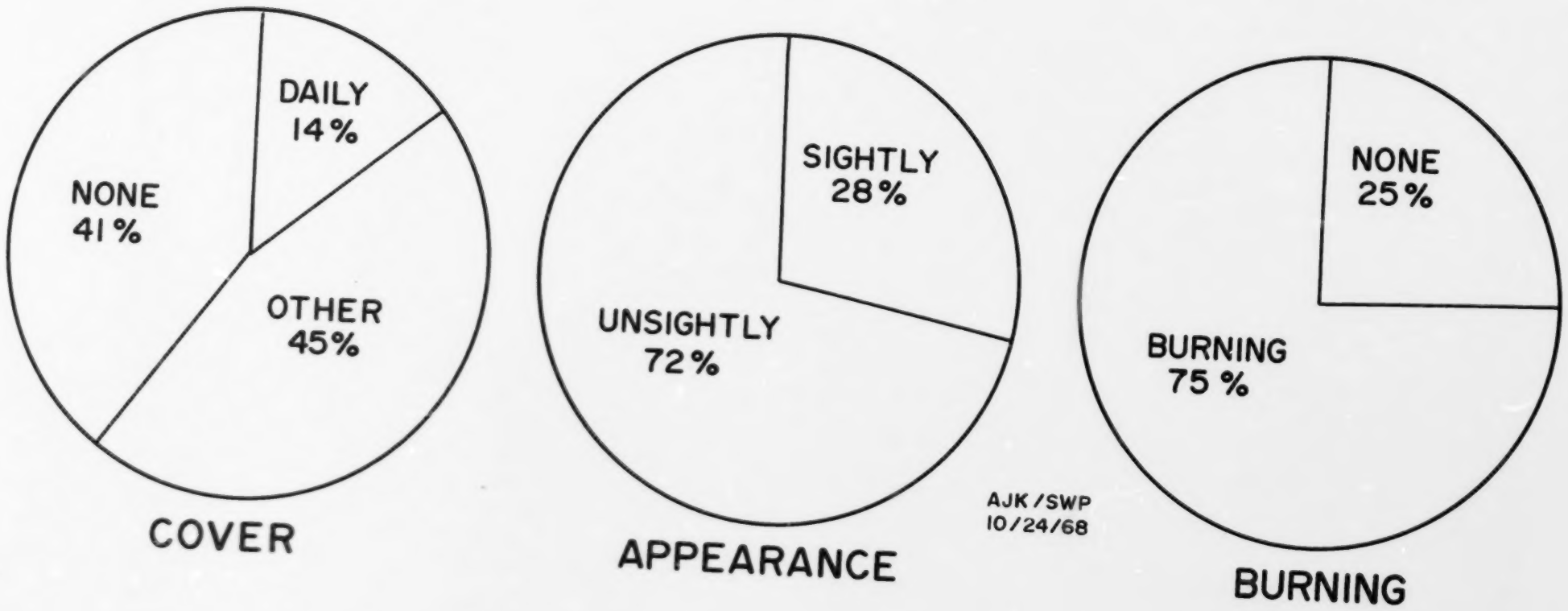


Figure 14. Quality of site operations (1968).

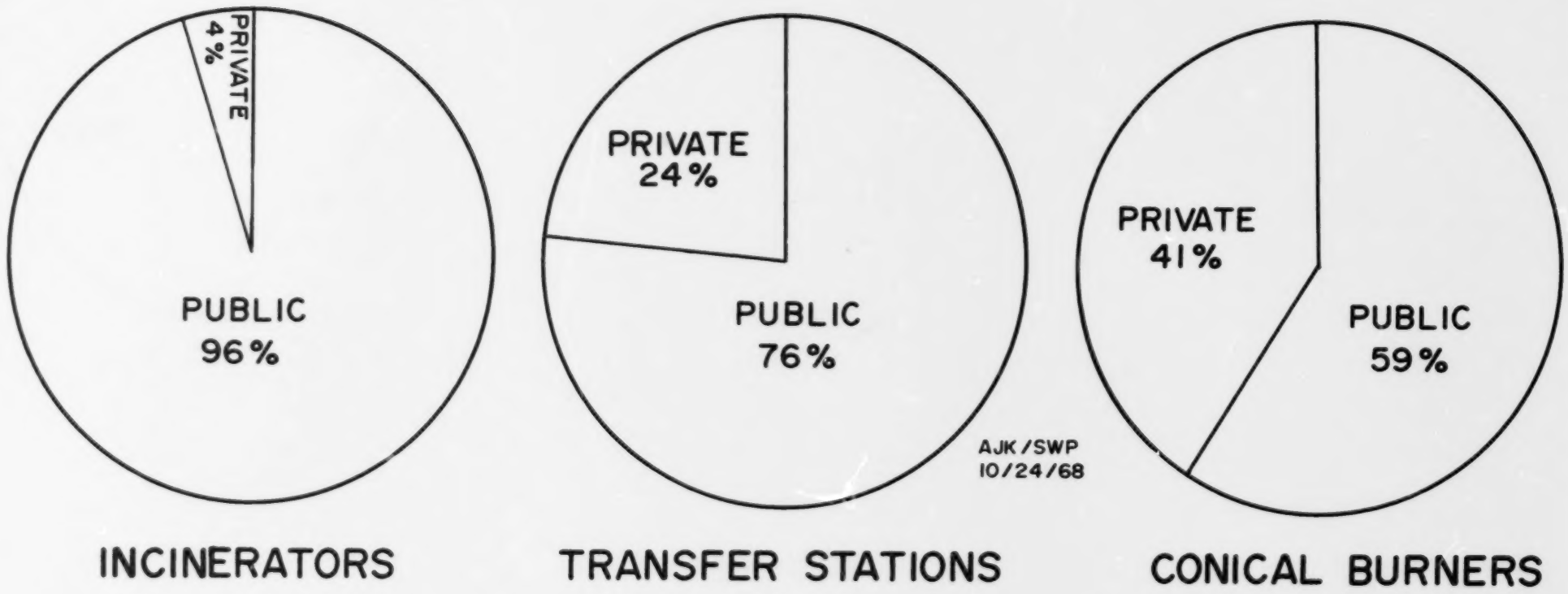


Figure 15. Disposal facility ownership and operation (1968).

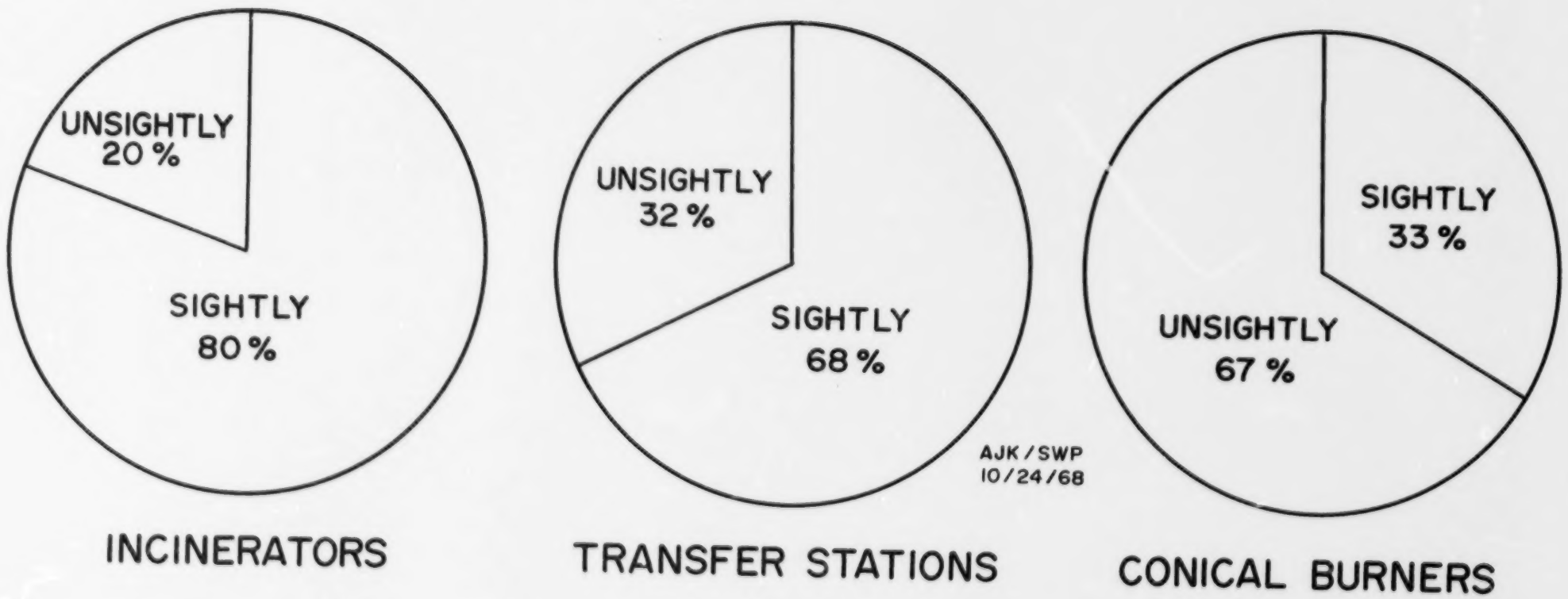


Figure 16. Disposal facility appearance (1968).

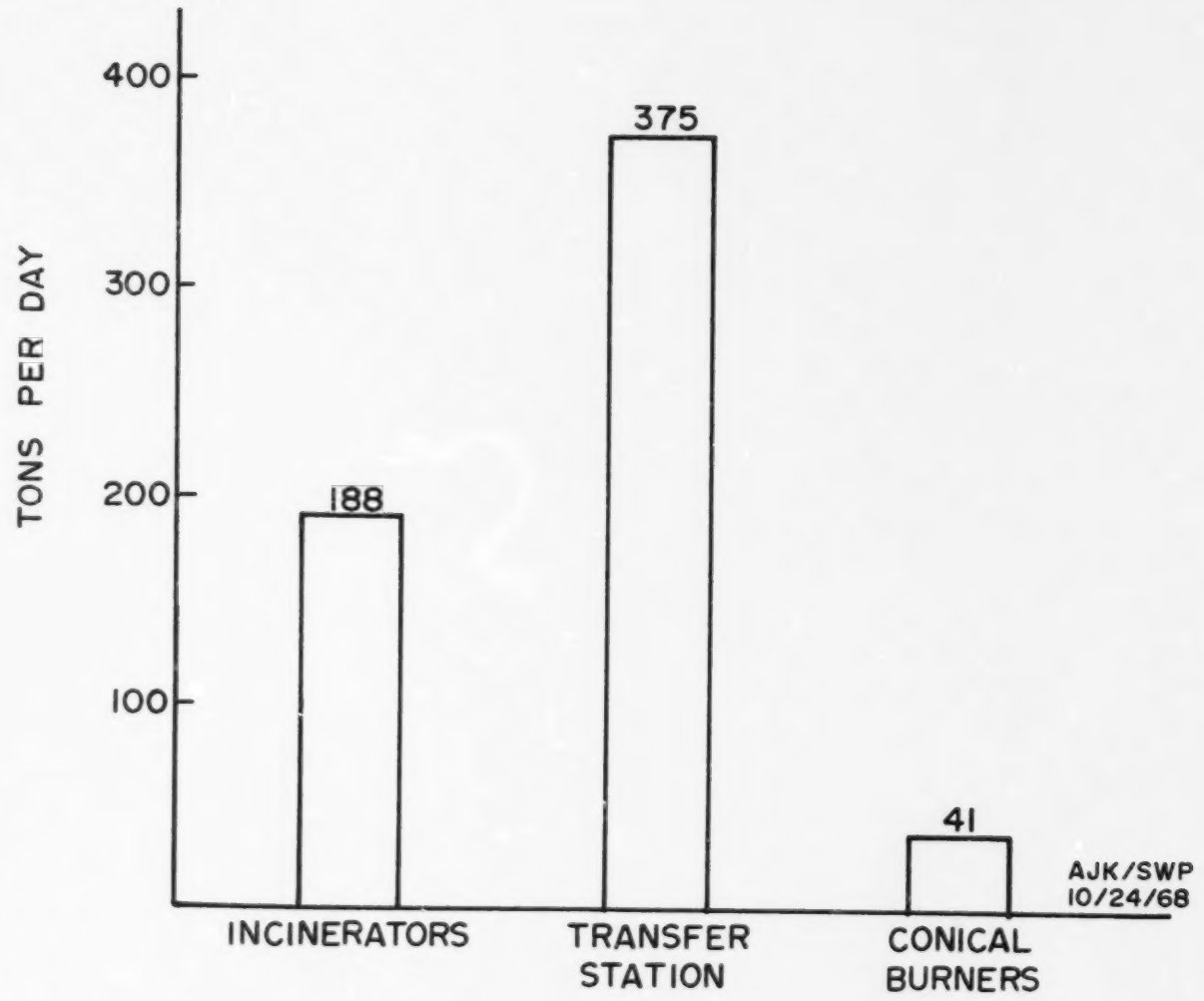


Figure 17. Average daily input of three types of U.S. facilities (1968).

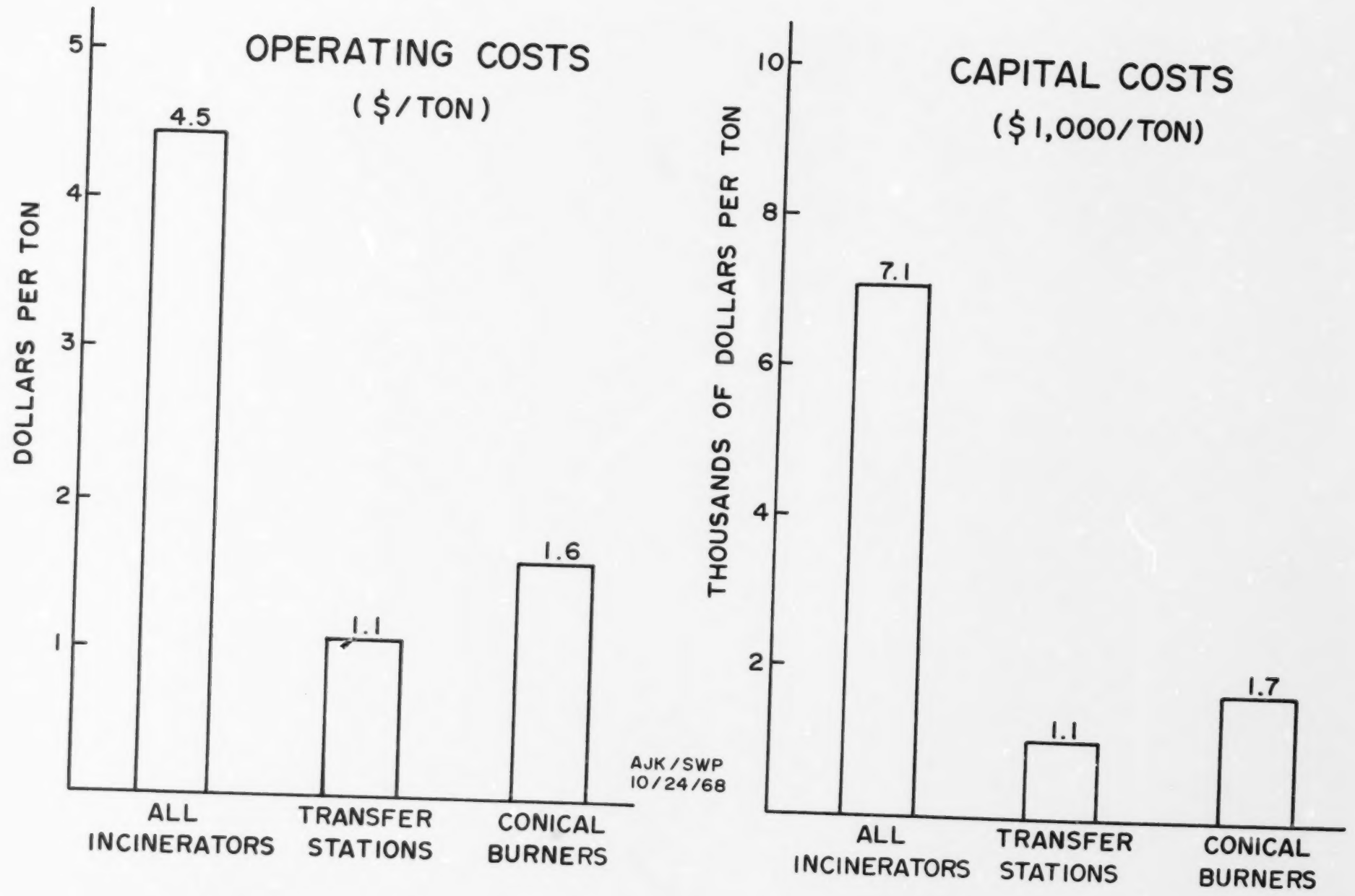


Figure 18. Operating and capital costs of the three basic facility types (1968).

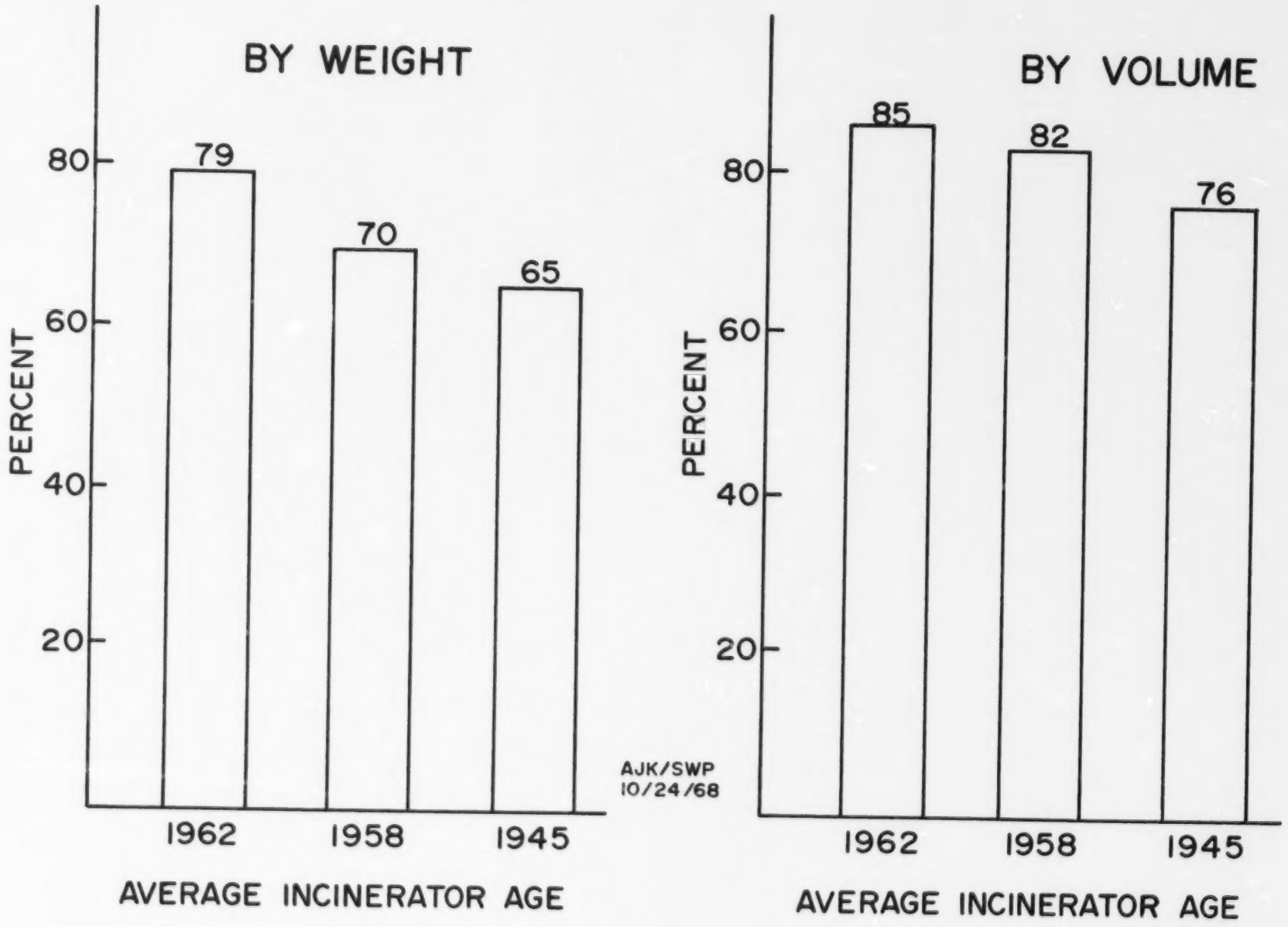


Figure 19. Percent reduction of solid wastes by incineration in the U.S. (1968).

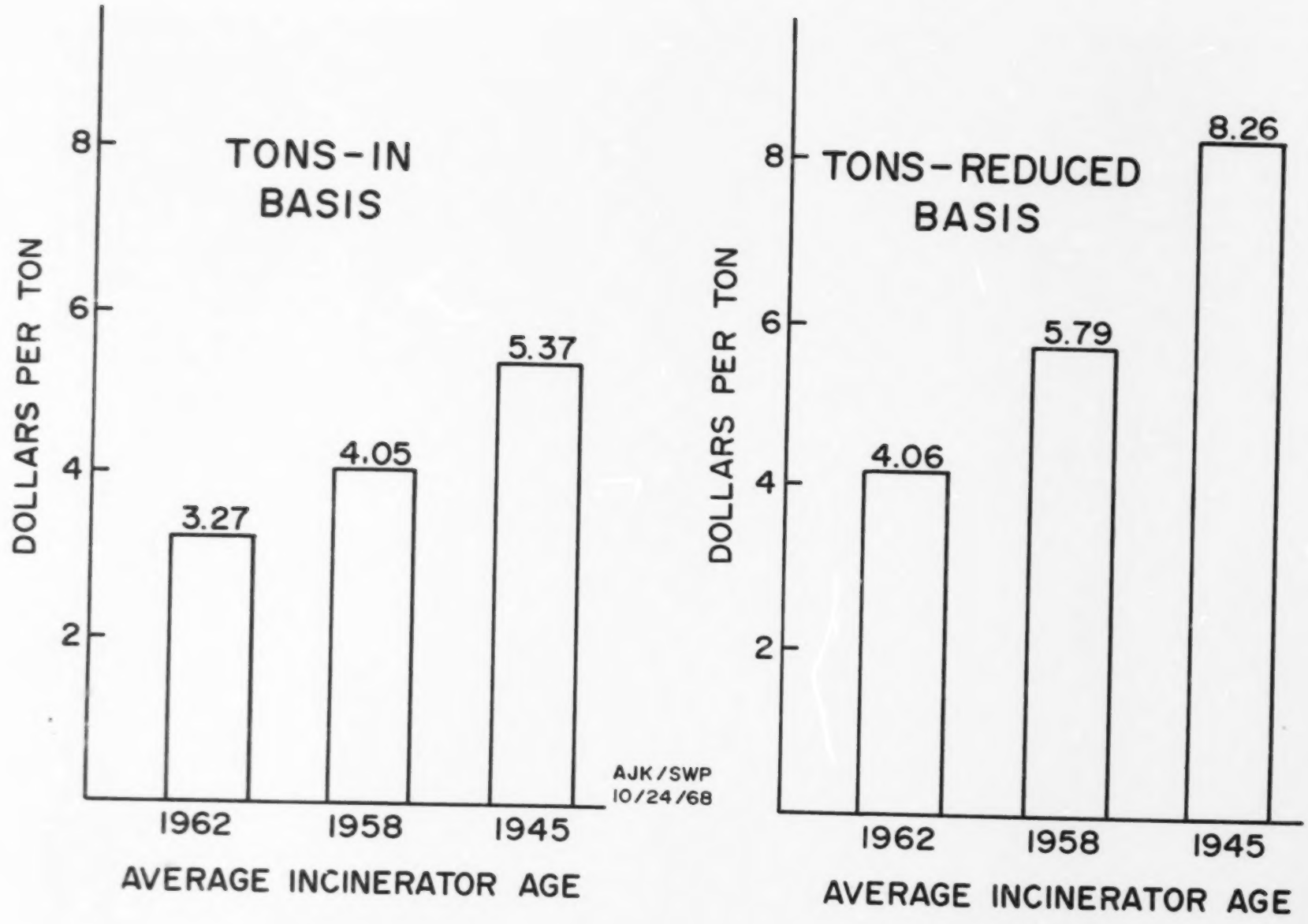


Figure 20. U.S. Incinerator operating costs (1968).

BLANK PAGE

The Challenge That The National Survey Presents

by H. Lanier Hickman, Jr.*

The data presented by Dr. Muhich and Mr. Klee indicate in definitive terms the magnitude of the problem that this country faces in solid waste management. The data provided serve also as indicators of what action must take place now and what planning is necessary for the future to assure protection of the environment.

It is significant that at present approximately 12 percent of the residential population receives no formalized collection service, and that another 11 percent receives only partial service. As we increase our efforts to improve solid waste management practices this deficiency must be reduced. This will require a more positive attitude on the part of government and industry to assure that these services are provided. Additionally, 14 percent of the population is served by systems that require separation of wastes at the source, yet their disposal operations have been combined. There is a need for review and updating of these collection systems to reflect contemporary technology. This review and updating will require initiative by personnel in the public works field to stimulate the political sector to support such efforts.

---

*Chief, Technical Services, Solid Wastes Program.

PRECEDING PAGE BLANK

It is inconceivable that this nation, which is making great strides in the control of water and air pollution from industrial sources, can ignore an industrial solid waste volume of such magnitude as that being discharged by municipal sources. It is significant that the National Survey can provide little information about industrial solid wastes. This lack of information indicates local government's reluctance to regulate or assist in the management of these wastes--a responsibility that is rightfully theirs. Too long has industry been left to fend for itself in solid waste management. The absence of uniform regulations and control has left industry with no option but to seek the easiest and cheapest method of management to remain competitive; this should not be. Uniform regulations and local government interest would require standard methods of management by all industry and allow the integration of municipal and industrial solid waste streams for better management.

This country has over 12,000 land disposal sites being utilized by collection services, control of which 94 percent are unacceptable and represent disease potential, threat of pollution, and land blight. By no stretch of the imagination do these sites resemble a sanitary landfill. The waste management field must face the challenge of studying and evaluating these sites to determine their ability for conversion to sanitary landfills. We must develop the necessary plans, finances, and action programs to convert those sites that can function as a sanitary landfill. In many instances it will be necessary to close and abandon many of these sites. Local government then must locate and develop new sites now for immediate use and to provide necessary capacities for the increase of the future.

There are approximately 300 incinerators in this country, 70 percent of which are without adequate air pollution control devices. Many produce residues and quench waters that are released into the environment without adequate treatment and control. These incinerators must be studied, evaluated, and upgraded to meet the more stringent pollution control regulations now being promulgated in this country. In many instances, complete abandonment of these facilities will be necessary because of their antiquated designs and capabilities. Because many communities are without adequate space for sanitary landfill, new incinerator plans will be needed. The current level of the solid waste load being treated by incineration (8%) may have to be increased to help do the job.

All of these needed and necessary improvements and increased efforts are going to require large increases in manpower, capital investments, and operating expenses. To operate existing disposal sites as sanitary landfills may require well over 10,000 new sanitary landfill operators. Further, efforts must be made on an intensive capital development basis to provide the maximum amount of automation and control for incinerators and the minimum amount of manpower. The current concept of the manpower required in incineration operation must be completely changed. We can no longer afford to overstaff our incinerators in an effort to operate antiquated and poorly designed facilities beyond their capabilities. To attract and retain the manpower with the qualifications needed, salaries and benefits for solid waste personnel must be increased severalfold. The solid waste management field, both public and private, must make efforts to train personnel and provide the opportunity for a feeling of pride in their work.

Finally, those working in solid waste management must decide what is going to be required to upgrade, improve, and enlarge their systems to the levels necessary to protect the environment and provide adequate services at a reasonable price. We must begin today to develop the timeframe necessary for financing the program development that will allow for a reasonable and rational management program at all levels of government. This timeframe must be developed so that government and the general public can begin to understand the benefits and costs of adequate solid waste management. We must begin now.

Mr. Vaughan will now summarize the Solid Wastes Program presentation and draw conclusions from the National Survey.

National Solid Wastes Survey

Report Summary and Interpretation

by Richard D. Vaughan*

What do these preliminary results imply about the solid waste problem in the United States? Up to now, when anyone asked how much solid waste is collected in this country, the usual response was either 3.5 or 4 or 4.5 lbs per person per day, depending upon who was answering the question. Our Survey results show that the average amount of solid waste actually collected in this country is over 5.3 lbs per person per day, or more than 190 million tons per year. What does this mean in terms of future collection of solid waste materials? During the past 5 years the per capita expenditure for consumption of durable and nondurable goods, rose by about 4 to 6 percent. Since production and eventual discard of these goods are responsible for the waste materials, it would be logical to suppose that the per capita waste production will increase at a similar rate. Assuming the conservative 4 percent annual increase in per capita generation, the amount of material to be collected through municipal and private agencies will rise to 8 lbs per person per day by 1980. Assuming a national population of 235 million by 1980, this means that over 340 million tons of solid waste will be collected.

---

*Chief, Solid Wastes Program.

But these figures reflect only the amount of material that is collected. It must be recalled that 10 to 15 percent of household and commercial wastes are collected or transported by the individual generating the waste. Approximately 30 to 40 percent of the industrial wastes are also self-collected and transported. Additionally, local regulations--or lack of them--permit over 50 percent of our population to burn some type of household waste in their backyards. About 45 percent of commercial and other establishments are also allowed to practice controlled open burning of some type. Thus, although the amount of waste material that has to be collected is staggering in itself, the amount of material that is actually generated and could pose potential collection problems is even more impressive. Conservative estimates indicate that 7 lbs of household, commercial, and municipal wastes are presently generated per person per day; this totals over 250 million tons per year. To this must be added our estimate of over 3 lbs per person per day for industrial wastes, amounting to an additional 110 million tons per year. Thus, estimates for 1967 indicate that over 10 lbs of household, commercial, and industrial wastes are being generated in this country for every man, woman, and child, totalling over 360 million tons per year.

To these figures we must add over 550 million tons per year of agricultural waste and crop residues, approximately 1.5 billion tons per year of animal wastes, and over 1.1 billion tons of mineral wastes. Altogether, over 3.5 billion tons of solid wastes are generated in this nation every

In the Survey it was seen that, on the average, almost $5.40 per person was budgeted by communities for collection activities. An additional $1.40 was budgeted by communities for disposal activities, giving a total per capita expenditure of $6.80 for both collection and disposal. Thus the total amount budgeted by municipalities is approximately $1.6 billion per year. But this figure does not include expenditures related to solid waste management which are of a nonbudgeted nature. This means, for example, that any monies expended for capital improvements and construction that are supported by bond issues and retired out of the general municipal budget are not included. It has been estimated that expenditures of this type would add about $100 to $120 million to the expenditure for municipal solid waste management, giving a grand total of over $1.7 billion per year.

We have seen, however, that the investment in both manpower and equipment by the private sector is greater than that of the municipal sector so far as collection activities are concerned. Since collection expenditures amount to approximately 80 percent of the budgeted municipal expenditures, we estimate that the yearly expenditure by the private waste management industry is approximately $1.8 billion.

These figures, of course, do not take into consideration the investment by individuals or private industrial organizations, that, because of necesssity or preference, handle and dispose of their own waste materials. Considering the per capita investment in refuse containers, garbage grinders, on-site and backyard incinerators, and the money invested by industry

for transporting and disposing of their own material, we estimate that the expenditure in the individual sector is about $1.0 billion annually. Thus, our current estimate of the annual expenditure to handle and dispose of the household, commercial, municipal, and industrial solid waste material in this country is $4.5 billion per year.

But, even with this impressive total expenditure, it must be concluded that present collection and disposal systems in this country are not really adequate. I believe the fact that 94 percent of existing land disposal operations and 75 percent of incinerator facilities are inadequate is a national disgrace which must be corrected if our environment is to be properly protected. In order to provide complete collection of household, commercial, and industrial waste materials, and, moreover, to upgrade the frequency of collection of these materials, it is estimated that an additional 12 percent of our total expenditures, or $540 million a year, must be allocated for operating expenses; this would entail an additional $20 million a year in capital expenditures for trucks and other equipment. Similarly, to upgrade our land disposal operations, an additional $80 million per year is needed in operating funds, while a total of $240 million, or almost $50 million a year for the next five years, is required for capital expenditures. Thus, an additional $130 million per year is required to upgrade our current land disposal operations.

But we must also rectify our past mistakes. If the cost of converting and covering existing open dumps is only 65 cents a ton, and if these

dumps are converted at a rate equal to current production, over $100 million per year for five years would be required to complete this task.

It is estimated that approximately $150 million is required to construct new incinerators for replacement of existing inadequate incinerators and conical burners. An additional $75 million is required for air pollution control equipment to upgrade or replace existing inadequate incinerators.

In summary then, it is seen that approximately $560 million per year is required to upgrade our current collection systems. Approximately $230 million per year is required to eliminate the open dumps now in use and improve the level of our sanitary landfill operations. An additional $45 million per year for five years will be required to provide adequate incinerator capacity. This represents a total of $835 million per year for five years required to upgrade existing collection and disposal practices in this country to a satisfactory level. This total is in addition to the estimated $4.5 billion spent annually for solid waste management. To these figures must also be added each year 4 to 6 percent of the previous year's total expenditure to allow for costs due to population growth and increased per capita generation of solid waste. This additional expenditure represents an increase of approximately 18.5 percent over the present funding level, which is not doing the job.

I should point out that the cost estimates are based upon the current ratio of land disposal practice to incineration. If this ratio changes in the future, the cost figures must be adjusted accordingly.

The cost estimates are also based upon use of current technology, current environmental control requirements, and constant dollars.

Thus we have presented a status of current solid waste management in this country and the costs required to upgrade this practice to a level that we as a nation can consider satisfactory and which I believe citizens will increasingly come to expect. The National Survey which is actually a Federal-State cooperative venture represents the best current estimate of solid waste management practice and problems in the United States today. I say estimate because most of the states found that very few records on the type, characteristics, sources, amounts, and disposition of solid wastes are actually kept. We all recognize the necessity to have good data for solid waste planning and problem solving, not only for the long term but on a daily basis as well. Additional effort will be made to stimulate record keeping at the local level so that even more meaningful information can be collected and evaluated.

The Solid Wastes Program, through sponsorship of research, and through various forms of financial assistance for planning and demonstrations, is furthering the technology of solid wastes management. But the application of this technology rests primarily with you--city and county public works officials, and those in the private sector engaged in solid waste management. The time to begin improving solid wastes practices is now. Fortunately, immediate improvement in solid waste management doesn't have to await some new technological breakthrough. If we will only apply,

on a nationwide scale, the best existing technology, we will have gone a long way toward ending the environmental blight and hazard which can no longer be accepted.

The theme of this year's annual meeting of the American Public Works Association is "Changes in Man and his Environment." I believe we have pointed out some very significant changes that man must make in his environment if we are to assure that the environment of the future adequately protects the public health, natural resources and scenic beauty of this nation. Let us work positively together for a better tomorrow.